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STEPHEN R. ROSS

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

BY HAND

Mr. William Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W.
Washington, D.C. 20554

Re: Ex Parte Comments, CC Dock et No. 92-297

Dear Mr. Caton:

Attached herewith is a faxed version of ex parte comments which GeoWave wishes to file in the above noted proceeding.

Thank you.

Sincerely,

Steve Ross

Enclosure

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FEDERAL COMMUNICATIONS COMMISSION
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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of Rulemaking to Amend Part 1 and Part 21 of the Commission's Rules to Redesignate the 27.7-29.5 GHz Band and to Establish Rules and Policies for Local Multipoint Distribution Service.	CC Docket No. 92-297

I. *Introduction*

GeoWave Corp. hereby requests that the FCC consider GeoWave's spectrum sharing technology in its decision on the 28 GHz band and requests formal comment from industry on GeoWave's **S**ynchronized **In**terservice **C**o-Frequency Sharing (SINC) technology. Using existing and deployed technologies, GeoWave's SINC eliminates interference from Teledesic's Standard Terminals into digital LMDS subscriber-to-hub links and delivers almost **twice the LMDS capacity** (1.8x) of other proposed co-frequency sharing techniques. The total LMDS and FSS hardware costs for implementing SINC is $2000 per digital LMDS hub, which represents a small fraction of a percent of the hub's cost. Other sharing techniques have been proposed to accept satellite interference at the expensive of costly ($50k to $200k) modifications to the hub, such as requiring a sectored hubs or additional tube amplifiers, but GeoWave's SINC avoids, rather than accepts, interference to deliver higher quality and higher capacity signals with omni-directional hub antennas.

In February of 1995, GeoWave presented its technique to the FCC, and in March and April, GeoWave disclosed its patent pending technology to Texas Instruments, Video/Phone, Bellcore (International CellularVision's research contractor), and Bell Atlantic. All of these LMDS proponents have stated that GeoWave's sharing technique is new and has merit, but they have chosen to formally evaluate the technique later. Recently GeoWave has contacted Teledesic and Teledesic believes the technique has already been proposed, which is in disagreement with LMDS proponents and in documentation from the 28 GHz Negotiated Rulemaking Committee (NRMC) report, see section II. GeoWave's SINC technology releases 400 MHz of bandwidth for FSS and LMDS to share without interference and eliminates the interference issue between Teledesic's Standard Terminals and LMDS as the "worst case availability" scenario.[1] Other co-frequency sharing techniques have been proposed, but only GeoWave's SINC maintains high quality LMDS signals that permit GeoWave to double the capacity of non-SINC proposals, see section V.

II. *Need for and Operation of GeoWave's SINC*

The need for a new technical solution is well documented in the NRMC Report. According to the first page of the executive summary, "For FSS earth station transmitters interfering into LMDS receivers...the committee did not find a technical solution for co-frequency sharing" and "sharing problems were identified as resulting from the proposed widespread distribution of both FSS earth stations and LMDS receivers.." Similar statements are restated as the first conclusion on page 85. A digital LMDS system using the SINC technique removes this major interference issue with Teledesic's FSS system. Teledesic Standard Terminals, TSTs, are FSS earth stations for widespread distribution and the SINC technique removes interference from TSTs into neighboring digital LMDS receivers.

Even though SINC was unavailable during the chartered period of the Negotiated Rulemaking Committee, the NRMC Report has several inferences to the SINC technique. SINC is a time-sharing technique, and according to section 5.2 on pg. 38 of Appendix 6, "coordinated time sharing...could provide simultaneous use...by FSS and LMDS." Continuing on in the section, the report states, "Digital time sharing must overcome the difficulty of synchronizing transmissions from highly random locations," and "the economic impact of digital time-sharing is proportional to the difficulty in solving the synchronization issue."

The SINC technique solves the synchronization issue by linking the central nervous systems of FSS and LMDS, which are satellites and LMDS hubs respectively. A satellite continuously sends timing signals to its earth stations, and each LMDS hub can capture and synchronize to these timing signals with an inexpensive receiver located near or on top of the hub. In turn, the randomly located digital LMDS receivers and FSS earth stations,

[1] pg. 32 line 8 of Bellcore's April 1995 submission to the FCC

which are respectively controlled by the hub and satellite, will also be synchronized to prevent interference.

Teledesic uses a hopping spot beam for its Standard Terminals. The hopping spot beam emanates from the satellite and sequentially moves through nine 50x50 km cells on earth's surface, and the LMDS hub captures the timing of the hopping spot beam. While the hopping spot beam communicates with cells outside of the area surrounding the LMDS hub, the hub activates LMDS receivers for communications. When the hopping spot beam returns to the 50x50 km cell that encompasses the LMDS hub, the hub temporarily deactivates LMDS receivers. Overall the LMDS receivers remain active most of the time: the hopping spot beam requires one time interval for each cell, and the LMDS receivers in one given cell remain active for the eight timing intervals that a beam takes to sweep through eight other cells.

III. *GeoWave's SINC Requirements*

GeoWave's SINC makes use of three proven and deployed technologies: time division multiple access (TDMA), signal timing acquisition, and coincident geographical boundaries:

- TDMA is a well established handheld technology deployed by Bell Atlantic Mobile cellular carriers in Philadelphia, Washington, Baltimore and Pittsburgh.
- Signal timing acquisition is currently deployed using non-geostationary Global Positioning System (GPS) satellites and provide nanosecond accuracy to civilian earth stations,[2] which is nearly 1000 times the resolution needed for FSS-LMDS synchronization
- Coincident geographical boundaries are used by mobile service providers, and Bellcore has proposed coincident geographical boundaries for CellularVision's and Texas Instrument's LMDS with FSS to use in its Spectrum Protocol.[3] Coincident boundaries does not require modification of FSS spot beam patterns, and information from the FSS down link define boundaries by activating earth stations located inside activate cells.

Acquisition of the timing signal requires an inexpensive ($1000-$2000) receiver located near the LMDS hub, called the synchronizing receiver, and it costs a small amount relative to the hub itself. The synchronizing receiver uses a physically small 18-24 inch diameter dish. In the event that the timing

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[2] November 1993 Microwave Journal, pg. 124, on the Trak Model 8860 Primary Reference Clock

[3] Figure 4-1 on pg. 34 of Bellcore's April 1995 submission to the FCC

signal from the satellite is temporarily lost, an inexpensive crystal oscillator inside the synchronizing receiver can maintain the necessary timing for more than three hours. With the additional expense of $250 for an oven stabilized crystal oscillator, the receiver can maintain for timing for two days.

IV. *Implications of SINC for Teledesic*

The SINC technique is a form of time division multiple access, which is normally thought of as a mitigated technique for users to share spectrum. In Appendix 6 of the report, Working Group 1 proposed time sharing as a "mitigating opportunity," and although SINC is a time sharing technique, SINC it is not a mitigated solution for satellite systems. By synchronizing to Teledesic's hopping spot beam, a digital LMDS system can use the frequency band in a given cell on earth's surface while the hopping spot beam is communicating with other cells. Thus, SINC is a non-mitigated solution for Teledesic since it requires no hardware changes to the FSS system and maintains the same capacity.

V. *Implications of SINC for LMDS*

SINC temporarily deactivates 400 MHz for 12% of the time, which translates to a 5% reduction in capacity compared to an unencumbered 1000 MHz LMDS system and would reduce the number of digital television channels from 333 to 316. **Compared to other co-frequency sharing proposals, SINC delivers twice the LMDS capacity given the same LMDS parameters.** In clear sky conditions with FSS interference, Texas Instruments and modified CellularVision systems[4] guarantee low quality signals (roughly 10dB C/N+I) for nearly 100% of the time, but GeoWave's SINC guarantees high quality (roughly 30dB C/N+I) for nearly 90% of the time using the same system parameters. Similar to a crowded bar where noise (the interference) makes conversation (the signal) difficult to hear, the lack of signal quality directly translates to slower and less conversation (capacity). GeoWave's SINC can use its high quality signal for high level 16QAM or 64QAM modulation to deliver two or three times the capacity for 90% of the time. Thus, SINC's overall capacity for the same 400 MHz is 1.8 to 2.7 times the capacity of other co-frequency proposals.

[4]Bellcore's April 1995 submission to the FCC

VI. *Application of GeoWave's SINC*

The SINC technology can be used to completely eliminate or greatly reduce interference from Teledesic's Standard Terminal earth stations into digital LMDS receptions. SINC removes all intracellular interference of FSS into digital LMDS and can be applied to LMDS subscriber-to-hub and hub-to-subscriber links:

- As on pg. 73 of Appendix 6 of the NRMC report, potential interference from Teledesic's Standard Terminals (TST) into TI's digital LMDS subscriber-to-hub links are intracellular, so **SINC eliminates TST interference into digital LMDS subscriber-to-hub links**
- In clear sky conditions, interference from TSTs into TI's hub-to-subscriber can occur in a very small area outside of the LMDS cell. **SINC greatly reduces the potential interference from TSTs into digital LMDS hub-to-subscriber links.** The potential interference is in an area behind the subscribers that are located along the cell boundary. With inexpensive modifications to the backside (180^o to back) radiation pattern of LMDS subscribers, the minimum separation between TST of LMDS subscribers could be reduced by a factor of 100 to 1000.

VII. *Summary*

GeoWave believes the FCC was correct in searching for a technical solution to sharing the 28 GHz band. Unfortunately, most of the NRMC's work concentrated on minimizing interference by spatial means: antenna locations, physical blockage, and antenna radiation patterns. These traditional mitigation techniques will succeed when the number of transmitter stations are small and limited in their physical deployment; however, in widespread deployment these traditional techniques will fail. Using well established technologies, SINC moves beyond these traditional techniques and uses temporal means to remove interference between neighboring satellite FSS earth stations and terrestrial LMDS receivers. GeoWave hopes the FCC and others concerned with the 28 GHz band give their full consideration to this technique given its feasibility and the importance of sharing spectrum.